Chapter 5

Conclusion

This project proposes the novel spectrum sensing techniques in CR network for SG communication. The proposed techniques have a minimum time requirement and give a better performance than the conventional spectrum sensing methods. Moreover, we consider two channel environments including AWGN channel and the channel that consider the noise uncertainty and path loss effect.

Firstly, we propose “double constraints adaptive energy detection (DCAED)” for spectrum sensing in cognitive radio network. DCAED changes the system threshold depending on the condition of communication channel. Different from other adaptive ED and conventional ED, DCAED exploits the interdependent between probability of detection and probability of false alarm through the critical sample to set a new threshold. Thus, we can conclude that the decision threshold of DCAED is controlled by 2 target accuracy of detection performance metrics. The simulation results show that DCAED gives an accuracy detection performance even at low SNR condition while it also highly achieve the requirements of IEEE 802.22 standard in perspective of sensing time. DCAED can be well implemented when the noise variance can be estimated by the secondary user. Moreover, DCAED appropriates to real-time application in practical cognitive radio network because it does need any prior knowledge about signal pattern of primary user and consumes short sensing time.

Secondly, we propose fast spectrum sensing with coordinate system (FSC). The FSC extracts only two significant features of the WM signals to build a new coordinate system as the SU’s knowledge base. The FSC algorithm determines the existence of a PU by comparing the FSC decision statistic to the FSC threshold. Using our new coordinate system, the FSC requires less space for SU’s knowledge base compared to that of other knowledge-based techniques. By measuring the magnitude of the weight of correspondence between the received signal and the coordinate system, FSC performs spectrum sensing with little computational burden and utilizes a short sensing time, while offering a detection accuracy close to that of MFD. The FSC can be well implemented by an SU, when the patterns of the PU signal are known to the SU, with much less computational complexity and sensing time than any of the other knowledge-based spectrum sensing techniques considered in this paper. Moreover, FSC is appropriate for real-time application because it uses a sensing time that is as short as that of ED.

Thirdly, we propose two novel schemes of two-stage spectrum sensing technique for CR. The proposed schemes are ED to CAV two stage spectrum sensing and ED to MME two stage spectrum sensing. The received signal is first monitored by the first stage such as ED. The first stage gives reliable detection at high SNRs environment. By exploiting CAV and MME technique as a second stage, our proposed algorithms give better detection performance than the existing two stage spectrum sensing techniques. The proposed schemes offer an accurate detection when the uncertainty of noise power occurs and use short sensing time at high SNRs environment. Even though the proposed techniques take the longest time in the sensing period among two-stage spectrum sensing techniques, they offer much more reliable detection than the others.

Finally, we introduce a modified- fast spectrum sensing with coordinate system (MFSC) which is re-derive some parameters form conventional fast spectrum sensing with coordinate system (FSC) in order to perform spectrum sensing under noise uncertainty together with path loss effect. Then the detection performance of three knowledge-based spectrum sensing techniques — MFD, LED and MFSC — are evaluated under these factors. From the simulation results, MFD gives the best detection performance among these techniques however its detection performance greatly degrades due to the occurrence of noise uncertainty. LED is the most robustness to the occurrence of noise uncertainty and also consumes the least space of database. MFSC algorithm is the most achievable of spectrum sensing requirement when it give high detection performance while consumes the least average sensing time under noise uncertainty.